REMARKS

The applicants appreciate the Examiner's thorough examination of the Application and request reexamination and reconsideration of the Application in view of the following remarks.

Claims 26-40 and 42 stand rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over U.S. Patent No. 5,212,988 to White et al. in view of U.S. Patent No. 5,918,258 to Bowers.

The subject invention results from the realization that a truly effective mass determining device is obtained by driving the membrane of a flexural plate wave sensor at a reference resonant frequency, placing a substance on the membrane of the flexural plate wave sensor, determining the frequency change in the membrane as the result of the deposition of the substance on the membrane, and determining the mass of the substance based on the change in the frequency within the membrane.

In a teleconference on August 1, 2004, the Examiner stated he would consider secondary considerations which are described in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459, 467 (1966) and MPEP 2141. The Supreme Court in *Graham v. John Deere Co.* outlined the four factual inquires as a background for determining obviousness:

> (A) Determining the scope and content of the prior art;
> (B) Ascertaining the differences between the claimed invention and the prior art;
> (C) Resolving the level of ordinary skill in the art; and
> (D) Evaluating any objective evidence of nonobviousness (i.e., so-called "secondary considerations").

Id.

Objective evidence or secondary considerations such as unexpected results, commercial success, long-felt need, failure of others, copying by others, licensing, and skepticism of experts

are relevant to the issue of obviousness and must be considered in eversy case in which they are present. *Id.* *Stratoflex, Inc. v. Aeroquip Corp.*, 713 F.2d 1530, 218 USPQ 871 (Fed. Cir. 1983); *Hybritech, Inc. v. Monoclonal Antibodies, Inc.*, 802 F.2d 1367, 231 USPQ 81 (Fed. Cir. 1986), cert. denied, 480 U.S. 947 (1987).

On January 7, 2005, Applicants submitted an Affidavit under 37 CFR §1.132 from Charles Spangler to show the commercial success and long felt need for the subject invention, evidence of licensing, and failure of others. In the Office Action dated February 9, 2005, the Examiner alleged that the Affidavit dated January 10, 2005 did not establish a nexus between the claimed invention and the evidence of commercial success.

Please find enclosed a further Affidavit under 37 CFR §1.132 from Charles Spangler which shows there is a clear nexus between the claims of the subject patent application and the economic success of the NanoScale 9100™ product which embodies the subject invention. In particular, as the Examiner requests, the Affidavit: (1) identifies the features that distinguish the invention from the prior art, (2) indicates how the features are reflected in the claims, and (3) shows that the commercial success is attributable to the provision of such claimed features of the subject invention.

As described in the enclosed Affidavit, U.S. Patent No. 5,212,988 to White et al. fails to teach, disclose or suggest allowing a solution to evaporate until particles remain on a membrane layer of a sensor or on a flexure plate wave sensor, as recited in independent claims 26 and 27, respectively.

White et al. also fails to teach, disclose or suggest automatically calculating the concentration of the particles in the solution based on the measured quantity of the solution and the mass of particles, in which the mass of particles is determined from detecting the shift in

frequency of a membrane layer or a flexure plate wave sensor due to the mass of the particles, also recited in independent claims 26 and 27, respectively.

U.S. Patent No. 5,918,258 to Bowers relates to the use of SAW sensing devices and thus fails to disclose the use of a sensor that includes a membrane layer or a flexure plate wave sensor. Similar to White et al., Bowers also fails to teach, disclose or suggest the features of independent claims 26 and 27, specifically, allowing a solution to evaporate until particles remain on a membrane layer of a sensor or flexure plate wave sensor; or calculating the concentration of the particles in the solution based on the measured quantity of the solution and the mass of particles, in which the mass of particles is determined from detecting the shift in frequency of a membrane layer or a flexure plate wave sensor due to the mass of the particles.

Also, both White et al. and Bowers fail to teach, disclose or suggest the features of independent claim 28, specifically, a concentration detection system that includes a sensor having a membrane layer, a transducer for detecting the change in frequency of the membrane layer due to the particles after a solution evaporates; and a processor configured to automatically determine the mass of the particles based on the change in frequency, and to calculate the concentration of the particles in the solution based on the mass of the particles and the quantity of the solution deposited. Independent claim 30 includes similar features and is directed to a flexure plate wave sensor.

Claim 26 of the subject invention recites, "[a] method of measuring the concentration of particles in a solution, the method comprising: depositing a measured quantity of the solution on a sensor having a membrane layer; allowing the solution to evaporate until the particles remain on the membrane layer; driving the membrane layer at a reference resonant frequency; detecting the shift in frequency of the membrane layer due to the mass of the particles; determining the

mass of the particles based on the shift in frequency; and based on the measured quantity of the solution and the mass of the particles, automatically calculating the concentration of the particles in the solution." Independent claim 27 recites features similar to claim 26 but relates to the use of a flexure plate wave sensor. Independent claims 28 and 30 relate to concentration detection systems that include either a sensor having a membrane layer or a flexural plate wave device, respectively. Neither White et al. nor Bowers teach, disclose or suggest the features of these claims as described above.

There is a clear nexus between the claims of the subject patent application and the economic success of the NanoScale 9100™ product as described in Applicants' Response dated January 7, 2005 and reiterated below. The NanoScale 9100™ product has achieved its economic success due to the stated differences between it and the prior art. As evidence of this, the differences between the prior art and the claimed invention are clearly promoted in the enclosed brochure for the NanoScale 9100™ product, thus showing a significant nexus between the subject patent application and the commercial significance of the NanoScale 9100™ product.

Specifically, page 1 of the enclosed brochure for the NanoScale 9100™ product states that:

> [t]he Nanoscale 9100 is a simple, fast and inexpensive mention for measuring <u>[nonvolatile residue] concentration</u> in any liquid sample using a minimal sample volume. With its built-in heater the gravimetric sensor is continuously temperature stabilized and <u>the time required for evaporation is minimized</u>.

(Emphasis added.) Page 2 of the same brochure expands upon the commercial significance of the NanoScale 9100™ sensor:

NanoScale 9100 - Unique Sensor Technology
The [Flexure Plate Wave] sensor operates as a mass detection device by registering a decrease in the resonant frequency of a thin silicon membrane when mass is deposited on its surface. Because the resonant frequency shift is proportional to the amount of deposited mass, the sensor can be used to quantify the amount of material on the surface. The accuracy is determined by the sensors [sic] inherent sensitivity and by the frequency resolution of the electronic circuit used to drive the resonant mode.

(Emphasis added.)

Thus, the attached brochure makes clear that the commercially significant aspects of the NanoScale 9100™ product closely correspond to the features of the subject invention as claimed.

Also, there is a nexus between the stated objects of the subject invention and the commercial success of the NanoScale 9100™ product. One of the objects of the invention includes providing an apparatus and method that is capable of determining the mass of a substance with a resolution in the nanogram range, and that is capable of determining the mass of a substance in a quick and simple manner. It is another object of the invention to monitor the change in the reference resonant frequency of a flexural plate wave sensor to determine the mass of a substance disposed on the sensor. See the subject patent application at page 3, lines 6-18. Features corresponding to these objectives are clearly mentioned in the enclosed brochure for the NanoScale 9100™ product, thus showing a clear nexus between the subject patent application as claimed and the commercial significance of the NanoScale 9100™ product.

Also noted in both of the Affidavits of Mr. Spangler, the first submitted with the Applicants' Response dated January 7, 2005 and the second Affidavit submitted herewith, Mr. Spangler is the Director of Operations at the RJ Lee Group, Inc., which has taken a license from The Charles Stark Draper Laboratory, Inc. for the above-identified patent application. In particular, the RJ Lee Group, Inc. took a license for this patent application because the subject

invention provides the ability to measure Non-Volatile Residue (NVR) concentrations at the nanogram and the sub-nanogram level and because the invention is able to operate significantly faster than the prior art. The RJ Lee Group, Inc. manufactures the NanoScale 9100™ product. A brochure of the NanoScale 9100™ product, which embodies the subject invention, is enclosed with the attached Affidavit.

After the RJ Lee Group, Inc. began manufacturing the NanoScale 9100™ product, it won the Clean Technology Award of 2002. A copy of the award letter is also enclosed with the attached Affidavit. This award clearly shows that those skilled in the art recognize the significance of the subject invention as novel and innovative. In particular, the award letter states that the NanoScale 9100™ product was chosen from the editors' list of 15 qualifying candidates and that the product is an "outstanding technology" that "offers revolutionary benefits to our readers".

Since the RJ Lee Group, Inc. began manufacturing the NanoScale 9100™ product there has been incredible market demand for this product showing not only commercial success, but a long felt need for the product. Twenty-three different companies have made separate inquiries about purchasing the NanoScale 9100™ product thereby showing a long-felt need for a product of this type. Among the well known companies that have inquired about purchasing the NanoScale 9100™ product are the Kennedy Space Center, the Stennis Space Center, Boeing, Boeing Commercial Aircraft, Rocketdyne, the Crane Division of the Naval Surface Warfare Center, the Los Alamos National Laboratory, Procter & Gamble, the Lawrence Livermore National Laboratory, Eli Lilly and Company, and Pfizer. Many of these companies have independently contacted the RJ Lee Group, Inc. about the NanoScale 9100™ product after hearing about the product.

Prior art devices could perform NVR measurements, but these devices could take several hours to complete a measurement that the subject invention could perform in minutes. As shown by the remarkable demand for the NanoScale 9100™ product, there has been a failure of other companies to bring to the market a comparable product that offers the advantages of the NanoScale 9100™ product.

The RJ Lee Group, Inc. has agreed to pay a substantial license for the subject invention which includes paying a royalty for each individual sale of the product associated with the subject invention. The RJ Lee Group, Inc. agreed to such a license for the subject invention because it recognizes its commercial significance of the subject invention as claimed by Applicants.

There is a clear nexus between the secondary considerations of the NanoScale 9100™ product described above and the subject patent application. The stated objects of the subject invention include providing an apparatus and method that is capable of determining the mass of a substance with a resolution in the nanogram range, and that is capable of determining the mass of a substance in a quick and simple manner. It is also an object of the invention to monitor the change in the reference resonant frequency of a flexural plate wave sensor to determine the mass of a substance disposed on the sensor. See the subject patent application at page 3, lines 6-18. All of these objectives are clearly mentioned in the enclosed brochure for the NanoScale 9100™ product, thus showing a clear nexus between the subject patent application and the commercial significance of the NanoScale 9100™ product.

Thus, the secondary considerations stated above and in the attached Affidavit clearly indicate that the subject invention as claimed by Applicants is nonobvious.

As noted in Applicants' Response dated January 7, 2005, in addition to the considerations which clearly show the subject invention is nonobvious, the subject invention is also clearly nonobvious over the prior art since the prior art does not teach, disclose or suggest the subject invention as claimed by the Applicants.

White et al. shows an ultrasonic sensing device that uses a Lamb wave propagation medium. White et al. describes that the described apparatus marks a departure from the use of SAWs or Rayleigh waves in ultrasonic sensors and instead employs Lamb waves. White et al. do not disclose, however, depositing a measured quantity of a solution on a sensor having a membrane layer and allowing the solution to evaporate until particles remain on the membrane layer, as claimed by Applicants. Furthermore, White et al. also does not disclose or suggest automatically calculating the concentration of particles in the solution based upon the measured quantity of the solution and the mass of the particles. To overcome these deficiencies of White et al., the Examiner combines White et al. with Bowers.

In Applicants' Responses dated August 6, 2004 and April 7, 2004, it was submitted that the Examiner's combination of White et al. and Bowers is improper since <u>White et al. strongly teaches away from combining it with a reference such as Bowers</u>. In response to Applicants' arguments, the Examiner stated in the Office Action dated June 18, 2004 that:

> Bowers is relied upon merely to suggest a particular utility for the sensor of White et al., namely, in a particular evaporation system that may employ the sensor of White et al. as a deposition monitor. The level of ordinary skill in the resonant sensor art is high, and it is within the level of ordinary skill in the art to seek to extend the utility of a resonant sensor of general utility to applications of particular utility. Accordingly, it would have been within the level of ordinary skill in the art to seek to extend the utility of the resonant sensor of White et al. as a deposition monitor in an evaporation system to the specific utility as a deposition monitor in an evaporation system for measuring the level of non-volatile residue in the

> liquid, and Bower would have suggested such specific utility to one of ordinary skill in the art.

In short, the Examiner's motivation for combining the references is that the level of skill in the art is allegedly high. The case law is clear, however, that it is improper to combine references merely because the level of skill in the art may be high.

> This court has identified three possible sources for a motivation to combine references: the nature of the problem to be solved, the teachings of the prior art, and the knowledge of persons of ordinary skill in the art. <u>In this case, the Board relied upon none of these</u>. Rather, just as it relied on the high level of skill in the art to overcome the differences between the claimed invention and the selected elements in the references, it relied upon the high level of skill in the art to provide the necessary motivation. The Board did not, however, explain what specific understanding or technological principle within the knowledge of one of ordinary skill in the art would have suggested the combination. <u>Instead, the Board merely invoked the high level of skill in the field of art</u>. If such a rote invocation could suffice to supply a motivation to combine, the more sophisticated scientific fields would rarely, if ever, experience a patentable technical advance. Instead, in complex scientific fields, the Board could routinely identify the prior art elements in an application, invoke the lofty level of skill, and rest its case for rejection. To counter this potential weakness in the obviousness construct, the suggestion to combine requirement stands as a critical safeguard against hindsight analysis and rote application of the legal test for obviousness.
>
> Because the Board did not explain the specific understanding or principle within the knowledge of a skilled artisan that would motivate one with no knowledge of Rouffet's invention to make the combination, <u>this court infers that the examiner selected these references with the assistance of hindsight. This court forbids the use of hindsight in the selection of references that comprise the case of obviousness</u>. <u>See</u> <u>In re Gorman</u>, 933 F.2d 982, 986, 18 USPQ2d 1885, 1888 (Fed. Cir. 1991). Lacking a motivation to combine references, the Board did not show a proper *prima facie* case of obviousness. This court reverses the rejection over the combination of King, Rosen, and Ruddy.

<u>In re Rouffet</u>, 149 F.3d 1350, 47 U.S.P.Q.2d 1453, 1458 (Fed. Cir. 1998) (emphasis added).

Similar to the case of <u>In re Rouffet</u>, the Examiner in the present case fails to provide sufficient

motivation or teaching to combine the references of White et al. and Bowers. Rather, the Examiner asserts that the "level of ordinary skill in the resonant sensor of art is high, and it is within the level of ordinary skill in the art to extend the utility of a resonant sensor of general utility to application of particular utility." As the court noted in In re Rouffet, "[i]f such a rule invocation could suffice to supply a motivation to combine, the more sophisticated scientific fields would rarely, if ever, experience a patentable technical advance." *Id.*

Since the level of the art does not provide proper motivation to combine references, the Examiner's combination of White et al. and Bowers is improper since White et al. strongly teaches away from combining it with a reference such as Bowers. Throughout the Background of the Invention and the Summary of the Invention, White et al. describes the disadvantages of using SAW sensing devices, such as that disclosed in Bowers. For example, White et al. teach that:

> A number of problems arise in SAW sensing devices due to SAW characteristics or to the characteristics of the medium required for SAW propagation. One such problem is that it is difficult to operate SAW sensors while they are immersed in most liquids, a problem rendering them inappropriate for many biological and chemical sensing applications. The reason is that when SAW devices are immersed, the SAW velocity is higher than the velocity of sound waves through the liquid; a large amount of the SAW energy is therefore radiated into the liquid, and the wave is attenuated as it travels along the propagation medium.

(Emphasis added.) (White et al. at column 2, lines 1-12.) White et al. further teaches away from combining it with SAW sensing devices:

> The invention marks a departure from the use of SAWs or Rayleigh waves in ultrasonic sensors and employs instead Lamb waves, which are also known as plate mode waves. Lamb waves can propagate only a material of finite thickness. In contrast to SAWs, which require a propagation medium having a thickness on the order of tens to hundreds of times the wavelength of the SAW propagating

> therethrough, Lamb waves require a propagation medium which is at most only several wavelengths thick.

(Emphasis added.) (White et al. at column 3, lines 11-20.) White et al. further teaches that:

> Thus the sensor may be operated while immersed in fluids. <u>This is in contrast to SAW sensors,</u> in which SAW velocities are higher than the velocity of sound through most fluids, a characteristic <u>which renders typical SAW sensors inappropriate for operation while immersed in fluids</u>.

(Emphasis added.) (White et al. at column 5, lines 49-54.) Many other references are in White et al. that teach against the use of SAW sensing devices. Thus, White et al. <u>strongly</u> teaches away from the use of SAW sensing devices and thus strongly teaches against the combination of White et al. with Bowers. Thus, the combination of these references is clearly improper. Moreover, the <u>secondary considerations</u> stated above and in the attached Affidavit clearly indicate that the subject invention as claimed by Applicants is nonobvious. Independent claims 28 and 30 recite similar features that distinguish over the combination of White et al. and Bowers.

Accordingly claims 26-40 and 42 are patentable over the prior art. Applicants respectfully request that the Examiner withdraw the rejection of these claims.

Claim 41 stands rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over White et al. in view of Bowers and further in view of Ballato. However, since claim 41 depends from independent claim 28, claims 41 is patentable for at least the reasons stated above, and further patentable because it contains one or more additional features.

Accordingly, all claims are allowable over the prior art. Applicants respectfully assert that all claims are in condition for allowance.

If for any reason this Response is found to be incomplete, or if at any time it appears that a telephone conference with counsel would help advance prosecution, please telephone the undersigned or his associates collect in Waltham, Massachusetts, at (781) 890-5678.

Respectfully submitted,

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